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ACIDIC PRECIPITATION IN ONTARIO STUDY (APIOS)

AN OVERVIEW: THE EVENT WET/DRY DEPOSITION NETWORK
(1st revised edition)

ARB-142-85-AQM
APIOS-025-85

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October 1985

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PREFACE

Since the last publication of this document (July 1982), the Acidic Precipitation in Ontario Study (APIOS) Event Wet/Dry Deposition Network has undergone a number of changes to ensure that the deposition monitoring program continues to collect the highest quality data possible. Such changes include removal of problem sites and changes in operational procedures as part of a stringent quality assurance program. This document has been updated to reflect these changes. For a detailed description of the APIOS Event Wet/Dry Deposition Network's structure, operating and quality assurance procedures refer to the Technical and Operating Manual (Bardswick, 1983) and the APIOS Quality Assurance Manual (Ontario Ministry of the Environment, 1985).

1. INTRODUCTION

The phenomenon of acidic precipitation has been recognized as a regional, provincial and international-scale perturbation of the environment. The Air Resources Branch (ARB) of the Ministry of the Environment (MOE) has established two monitoring networks which operate under the auspices of the Acidic Precipitation in Ontario Study (APIOS). The APIOS Cumulative Wet/Dry Deposition Network and the APIOS Event Wet/Dry Deposition Network have been designed to collect data so that a quantification of both wet and dry deposition patterns can be ascertained.

Although the primary concern for both networks is the measurement of deposition, they differ accordingly by the temporal resolution of their sampling periods. The event (used interchangeably with the term daily) network collects precipitation and air filter samples on a daily basis to investigate the characteristics and to determine the origin of pollutants deposited in these events, i.e. short-term wet and dry deposition patterns. The cumulative network monitors on a 28-day cycle (on a monthly basis from the network's inception in September, 1980 to January 5, 1982 , collecting precipitation and air filter samples to measure long-term wet and dry deposition distributions.

Details of the cumulative network are described in the document "Acidic Precipitation in Ontario Study (APIOS). An Overview: The Cumulative Wet/Dry Deposition Network" (Chan et al., 1985) which is available from the Air Resources Branch. No further discussion of this network will be given in this document.

The event deposition network to be presented herein will be described according to its two components under the headings "Daily Wet Deposition Network" and "Daily Dry Deposition Network" respectively.

2. NETWORK OBJECTIVES

2.1 Daily Wet Deposition Network:

The objectives of this network are twofold:

1) To study the chemical composition, frequency and intensity of acidic precipitation episodes in the Province.
2) To determine the wet deposition of acid - related materials associated with air masses originating from different directions and, hence, from different emission source regions.

2.2 Daily Dry Deposition Network:

The objectives of this network are also two-fold:

1) To determine the amount and origin of airborne acid-related pollutants available for deposition in Ontario on a daily basis.
2) To estimate dry deposition rates of these pollutants on a daily basis by using airborne concentrations and appropriate deposition velocity values in the relationship:

$$\text{Flux } (\text{ug m}^{-2}\text{S}^{-1}) = 100 \times C(\text{ug m}^{-3}) \times V_d \ (\text{cm s}^{-1})$$

where flux = dry deposition per unit area per unit time

C = daily air concentration

V_d = average deposition velocity

Based upon these daily estimates, the dry deposition of acid-related materials associated with air masses originating from different sectors can then be determined.

3. NETWORK DESIGN

3.1 Daily Wet Deposition Network:

In order to fulfill its stated objectives, the design of the APIOS Daily Wet Deposition Network was based on the following requirements:

1) to make measurements on a daily basis
2) to locate samplers of spatial scales varying from local to regional to provincial.
3) to give special emphasis to sampling in areas of known high acidic deposition and/or high sensitivity to acidic deposition.
4) to locate the sampling stations along the prevailing flow direction for Ontario and along the Canada-United States border.

Four general areas of Ontario were chosen for the sampling program, namely the London, Kingston, Dorset and Atikokan areas. The former three are aligned along the prevailing flow direction for the southern part of Ontario and have significant levels of precipitation acidity (based on historical data). Dorset is an area of known acid sensitive lakes and is the focus of many scientific studies; London and Kingston, being located close to the United States border, can be used to determine directly the amount of deposition associated with emissions from the United States. The Atikokan area was chosen to monitor background concentrations of pollutants prior to the 1985 start-up of a coal-fired generating station at Atikokan. As well, within the zone of influence of the Atikokan generator lie the acid-sensitive lakes of the Boundary Waters Canoe Area of northern Minnesota.

Each of these sampling areas is designed to have 4 event precipitation collection sites. The 4 samplers within each cluster are separated into 2 groups of 2 samplers each. Between each group is to be a distance of 50 to 100 km. Within each group, the samplers are to be 5 to 10 km apart. At one site within each cluster, two sampling instruments are to run side-by-side for the determination of measurement precision. Since the inception of the network, one site from the Kingston area (Whitman Creek) and one site from the Atikokan area (Lac La Croix) have been removed because of siting and/or operating problems. The Whitman Creek site has been replaced by the Wilmer site.

3.2 Daily Dry Deposition Network:

One of the daily precipitation monitoring sites in each of the London, Kingston, Dorset and Atikokan areas was chosen as a Daily Dry Deposition Network site. The number of samplers in each region is significantly smaller than that for precipitation sampling because of smaller spatial variability in air quality data.

4. NETWORK SAMPLING LOCATIONS AND SITING CRITERIA

4.1 Daily Wet Deposition Network:

Based on the design criteria outlined in the previous section, the London, Kingston, Dorset and Atikokan areas were inspected for proper sampling sites. Determining the actual locations involved fulfilling both the aforementioned spatial requirements as well as meeting site-specific requirements. These latter requirements are described briefly here.

The overriding consideration in site selection is the prevention of sample contamination. This is accomplished by locating sampling sites away from local areal sources of pollution so that the samplers are regionally representative. In addition, the sampling instruments must be located at a site which has little or no potential for affecting the integrity of the collected samples, i.e. they must be clear of obstructions, and other site-specific sources of nearby contamination must be minimized. The following list summarizes the many sources of contamination that could affect the chemical integrity of samples, both wet and dry:

* urban areas (industrial activity, vehicular emissions, human activity)
* airports
* highways
* trees (obstructions, rain splash, organic debris, throughfall)
* buildings (obstructions, rain splash, emissions)
* unpaved roads (spray, salt, sand, airborne dust, vehicular emissions, snow ploughing, snow blowing)
* sewage treatment plants and aeration lagoons
* cultivated fields and orchards (herbicide and pesticide spraying, fertilizer emissions, airborne dust, organic debris)
* overhead wires
* oil or gas wells
* parking lots
* ground cover (rock, loose soil)
* marshes (emissions, insects)
* gravel pits
* salt or sand piles
* gardens

In addition to minimizing sample contamination, siting criteria must also take into account factors which affect the logistics and operation of samplers. Major considerations are:

* site characteristics (ground cover should be grassy and flat, and as open and cleared as possible)
* avoidance of obstructions (adhere to a minimum "sampler-to-obstruction" distance of 2.5 times of the obstruction height)
* surrounding vegetation (windbreaks approximately 200 m away improve sampler catch efficiency)
* accessibility (easy access required but must be remote from roads)
* topography (locations near hills and depressions should be avoided)
* electrical supply must be on-site
* safety (must be free from vandalism)
* personnel to regularly maintain sampler and collect samples.

To aid in a comprehensive evaluation of a site, a site criteria checklist (Appendix 1) is used. Acceptance of a site for sampling depends upon the meeting of most (if not all) of the siting criteria. To indicate the importance of proper siting in the APIOS program, site characteristics generally over-ride all other factors.

Sites in each of the London, Kingston, Dorset and Atikokan areas were selected according to these criteria. Some of the sites are located at Ministry of Natural Resources' parks and regional conservation authority areas, while others are on personal property. The actual sampling locations are shown in Figure 1 and listed in Table 1. It should be noted that locating this number of sites which satisfy all of the design and site selection criteria was extremely difficult particularly in the sparsely-populated region of northwestern Ontario. A lack of good sampling sites in this area has extended the desired range separating the pairs of samplers.

4.2 Daily Dry Deposition Network:

The site selection criteria for the air quality samplers is similar to those for precipitation samplers. However, only one sampler is located in each of the principal areas. They are located at Longwoods Conservation Area near London, Charleston Lake Provincial Park near Kingston, the MOE laboratory site at Dorset, and at the United States Forest Service's Fernberg Road monitoring site near Ely, Minnesota. A secondary sampler co-located at one of the monitoring sites is used for the determination of measurement precision.

5. INSTRUMENTATION

5.1 Daily Wet Deposition Network:

Each daily deposition monitoring site is instrumented with a wet-only precipitation collector and a precipitation depth gauge which is used to obtain a true measurement of precipitation depth.

The precipitation collector used is a modified Aerochem Metrics Model 301 wet-only Precipitation Collector. Each Aerochem Metrics sampler is supplied with a high-density polyethylene bucket: Precipitation is collected in disposable polyethylene/nylon laminated bags inserted into the buckets. This procedure eliminates the need for washing the vessel after each event and reduces sample handling.

The Aerochem Metrics collector has been used year round since November 1982. Modifications to the precipitation sensor of the Aerochem Metrics collector were carried out in 1984 to improve the sensor sensitivity for wintertime sampling.

An Atmospheric Environment Service standard rain gauge is used to measure the precipitation depth during the summer months. A standard Nipher-shielded snow gauge provides an accurate daily precipitation depth measurement for the winter period from November to April (Northwestern region only) or from December to March (all other regions). The instrumentation used for daily wet deposition monitoring is shown in Figure 2. Samples are collected at 0800 hrs. local time for all sites.

5.2 Daily Dry Deposition Network:

The instrumentation at each daily dry deposition network site consists of an air filtration system for the determination of ambient concentrations of sulfur and nitrogen compounds. It consists of a set of multi-stage filter packs, a flow controller/time sequencer and a 10 m tower (see Figure 3). Within this system, specific filter types are used to sample for specific compounds.

Nine filter packs are mounted at the top of the 10 m tower once per week. Seven of the nine packs sample for 24 hours each during a typical week (the eighth one is also used when an extension to the eighth sampling day is necessary). The ninth pack remains passive (the passive value is used to correct filter loadings due to passive sampling).

The filter packs used in the network are modified 'Swinnex' two-stage, 47 mm, polypropylene units manufactured by Millipore Corporation. Each filter pack samples for 24 hours (commencing at 0800 hrs. local time) at a flow rate of 20 litres per minute. This flow rate is maintained by a Gast, heavy-duty diaphragm pump and is controlled by a Metrex Instruments Ltd. SAS8-25 Sequential Air Sampler. This latter instrument is designed to be connected to the 8 active filter packs and will automatically sequence through the filter packs at 24-hour intervals. The associated 24-hour total volumetric flow through each filter pack is automatically recorded on digital counters.

Individual filter packs are loaded with 3 types of filters, each type specific for certain pollutants (Figure 4). The upstream filter is a Membrana (Ghia) Corporation 47 mm, 2 um teflon filter which collects particulate sulfate, nitrate and ammonium. The teflon filter is followed by a Membrana (Ghia) Corporation 47 mm, 1 um nylon filter, used for the selective adsorption of vapor phase nitric acid. Both filters are loaded in the upstream stage of the filter pack and are in direct contact. The final filter type is a pair of 50 mm Whatman 41 cellulose filters impregnated with a potassium carbonate/glycerol solution. This impregnating solution selectively absorbs sulfur dioxide (SO_2). These filters are loaded in the downstream stage of the filter pack and are also in direct contact.

The filter pack sampling therefore provides daily measurements of particulate-phase sulfate, nitrate and ammonium as well as vapor phase nitric acid and sulfur dioxide. There is some evidence that the speciation of the nitrogen compounds using this type of selective sampling is subject to errors because of adsorption, desorption and volatility properties of the compounds. It is felt, however, that the summation of the NO_3^- and HNO_3 on the teflon and nylon filters (respectively) is an accurate measurement of total ambient nitrates. The nylon filter is also analysed for SO_2(as $SO_4^=$) due to artifact formation.

6. SAMPLE COLLECTION AND HANDLING TECHNIQUES

6.1 Daily Wet Deposition Network:

For the purposes of this network, a daily precipitation sample is defined as that precipitation collected within a 24 hour period starting at 0800 hours local time of one day and ending at 0800 hours the following day. The sampling protocol is as follows:

Every day at 0800 hours, the site operator at each station checks the sampler. The Aerochem Metrics sensor is activated and the collection vessel is inspected for precipitation. If no precipitation was collected, the collection vessel is left in place and the hood is returned to the closed position. The standard precipitation gauge is then inspected for precipitation. This provides a check on proper Aerochem Metrics sampler operation. If precipitation did occur and was collected in the Aerochem Metrics sampler, the sample is removed and replaced with a new sample bag insert. Precipitation collected in the standard gauge is measured and noted. The sample is then transferred to a 450 ml polystyrene sample bottle and stored in a refrigerator on site. For volumes greater than 450 ml, the excess volume is measured and discarded. All pertinent information is noted on a sample submission form which accompanies each sample. As part of a quality assurance program, information regarding factors affecting the collected sample is recorded in a log book on site.

Samples are picked up weekly from the on-site operators by APIOS technicians responsible for the samplers in their area (samples from the more remote sites in northwestern Ontario are sent in to the regional MOE office weekly). The samples are transported in coolers with ice packs to the regional MOE offices. The samples are weighed for the determination of sample volume followed by a field pH measurement (if the sample volume exceeds 95 ml). The samples are shipped in coolers with ice packs by courier service to the MOE Laboratory in Toronto. In Toronto, the samples are logged in, stored in a cold room at $4^{o}C$ and then are delivered to the Water Quality Section of the laboratory as soon as possible after receipt.

The use of polyethylene/nylon bags in the daily network is emphasized because of their inherent advantages to quality control. Each bag represents a

pristine collection vessel for each precipitation sample so that site-to-site variability in collection vessel cleaning procedures is eliminated. Laboratory analysis of the bags has been carried out and no significant adsorption or desorption of the inorganic constituents of interest (refer to Section 7.1) onto the bag surface has been observed.

6.2 Daily Dry Deposition Network:

The filter pack samples obtained in this network are collected over a 24-hour period beginning and ending at 0800 hrs. local time. The sampling protocol is as follows: Once per week an unexposed set of 9 filter packs is loaded with teflon, nylon and impregnated Whatman 41 filters and taken to the sampling site. At the site, the tower is lowered and the exposed filter packs are removed and bagged. The new filter packs are mounted in the housing unit on the tower and are elevated to 10 m. The flow volumes for each of the exposed filter packs are recorded and the sampler is then reset for the new sampling period.

At the regional MOE office, the filter packs are unloaded and individual filters are bagged and labelled. The filters are then submitted to the MOE Laboratory in Toronto for their respective analyses.

7. CHEMICAL ANALYSES

7.1 Daily Wet Deposition Network:

All daily precipitation samples are analysed for the following parameters (listed in descending order of priority): pH and total acidity, $SO_4^{=}$, N-NO_3^-, Cl^-, conductivity, N-NH_4^+, Na^+, K^+, Ca^{++} and Mg^{++}. The methods of analysis are given in Table 2.

7.2 Daily Dry Deposition Network:

The individual filters are analysed for the following parameters: $SO_4^{=}$, N-NO_3^- and N-NH_4^+ from the teflon filters; N-HNO_3 (as nitrate) and SO_2 (as $SO_4^{=}$) from the nylon filters; SO_2 (as $SO_4^{=}$) from the impregnated Whatman 41 filters. Methods of extraction and analysis are given in Table 3.

8. DATA HANDLING AND ANALYSIS

8.1 Daily Wet Depositon Network:

The reporting of chemical analysis data is structured such that laboratory-approved data are entered from the Laboratory Information System (LIS) into the Ministry's Sample Information System (SIS) data base. Supporting field data for a particular sample submission are merged with chemical data. Before results are finalized, they are screened using ionic balance testing, theoretical vs. observed pH and conductance checks, exceedence of range tests and Dixon-ratio statistical testing (comparison of chemical values for designated geographical regions over the same time interval). Validation flags are appended to individual analytical results to indicate failure of these tests.

Analysis of the data are to include:

1. the calculation of daily wet deposition rates as the product of pollutant concentration and true precipitation depth.
2. the characterization of events with respect to precipitation chemistry, depth and deposition.
3. the correlation of daily deposition data with air parcel trajectories for the determination of the origin of the pollutants.

Reports of event concentration and deposition data listings, annual statistics and interpretations are published on a regular basis.

8.2 Daily Dry Deposition Network:

Data from this network undergo the same transfer and screening procedures as the wet deposition data. Anomalous data are flagged by various office comments.

Analysis of these data will be similar to the wet deposition data with the exception that dry deposition rates will be calculated as the product of pollutant air concentration and published values of dry depositon velocity.

Additional analyses will be done to correlate concurrent wet and dry deposition data. Reports similar to those of wet samples are published on a regular basis.

REFERENCES

Bardswick, W.S., The Acidic Precipitation in Ontario Study - "Technical and Operating Manual", April 1983.

Chan, W.H., D.B. Orr, W.S. Bardswick and R.J. Vet. The Acidic Precipitation In Ontario Study - "An Overview: The Cumulative Wet/Dry Deposition Network (2nd revised edition)". Air Resources Branch, Report #ARB-141-85-AQM, October 1985.

Ontario Ministry of the Environment, Acidic Precipitation in Ontario Study - "Quality Assurance Manual", 1984. A report prepared for the Air Resources Branch by Concord Scientific Corporation. Report #ARB-051-85-AQM.

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Figure 1

APIOS Event Wet/Dry Deposition Network Station Locations

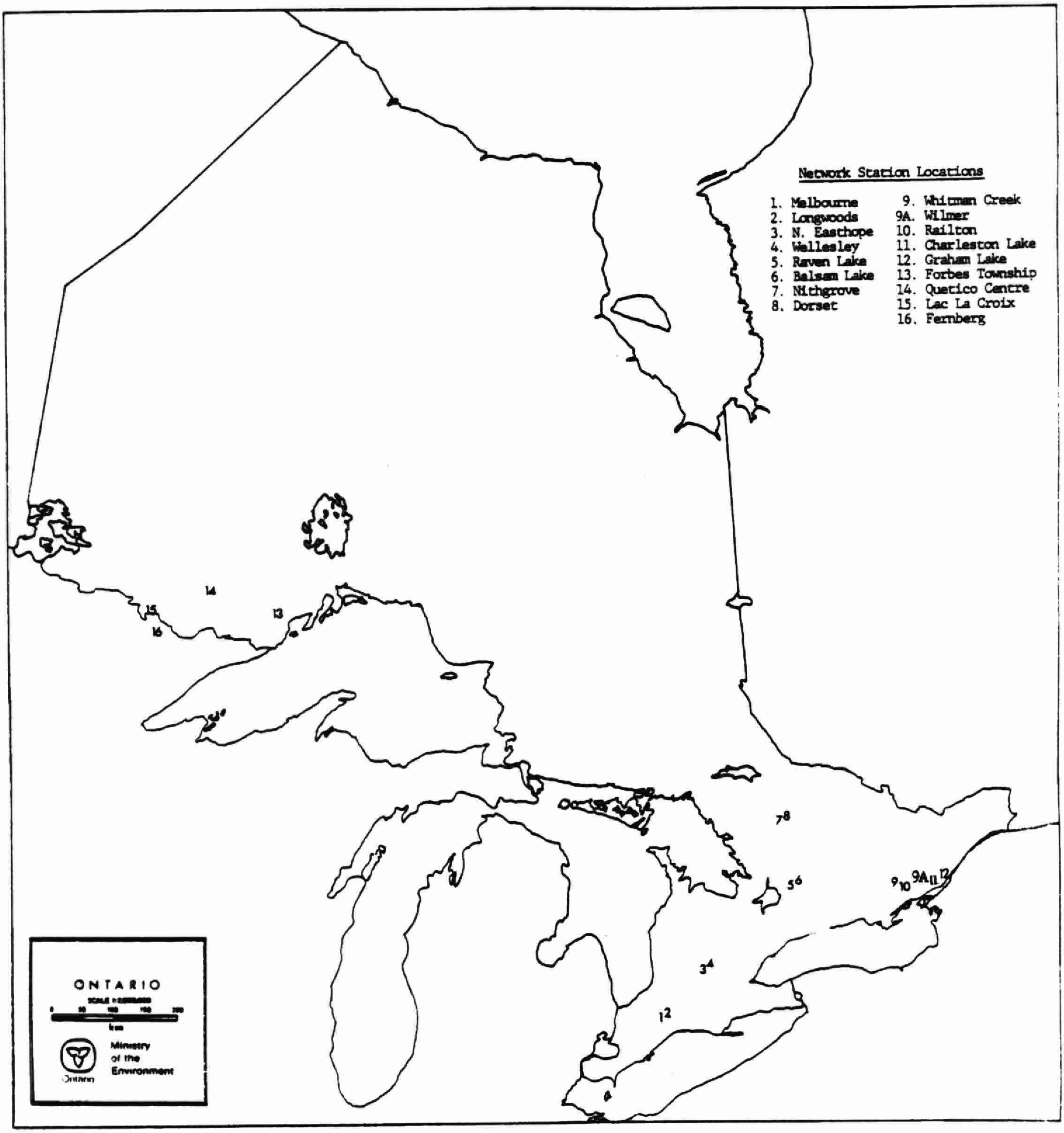


Figure 2. Instrumentation Used in APIOS
Wet Deposition Monitoring

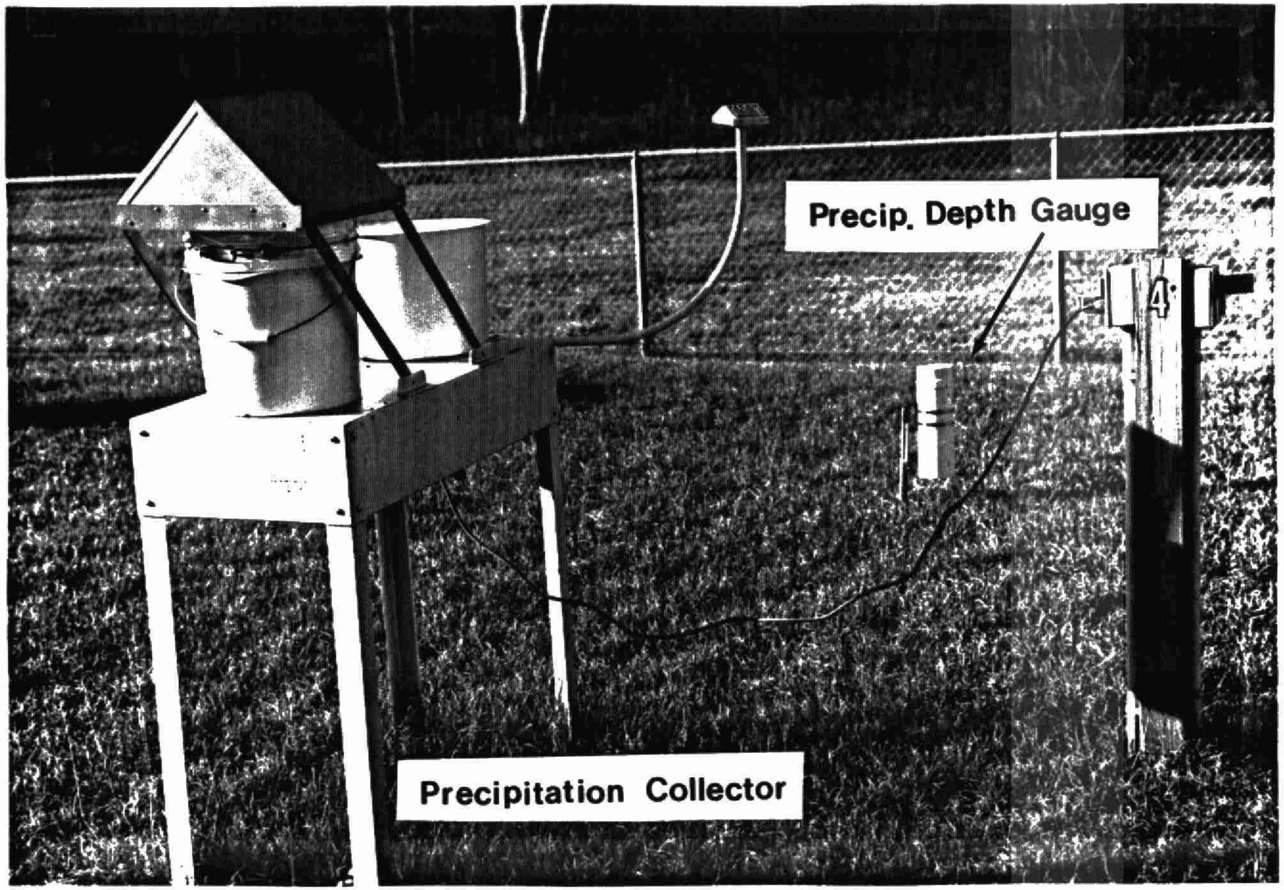
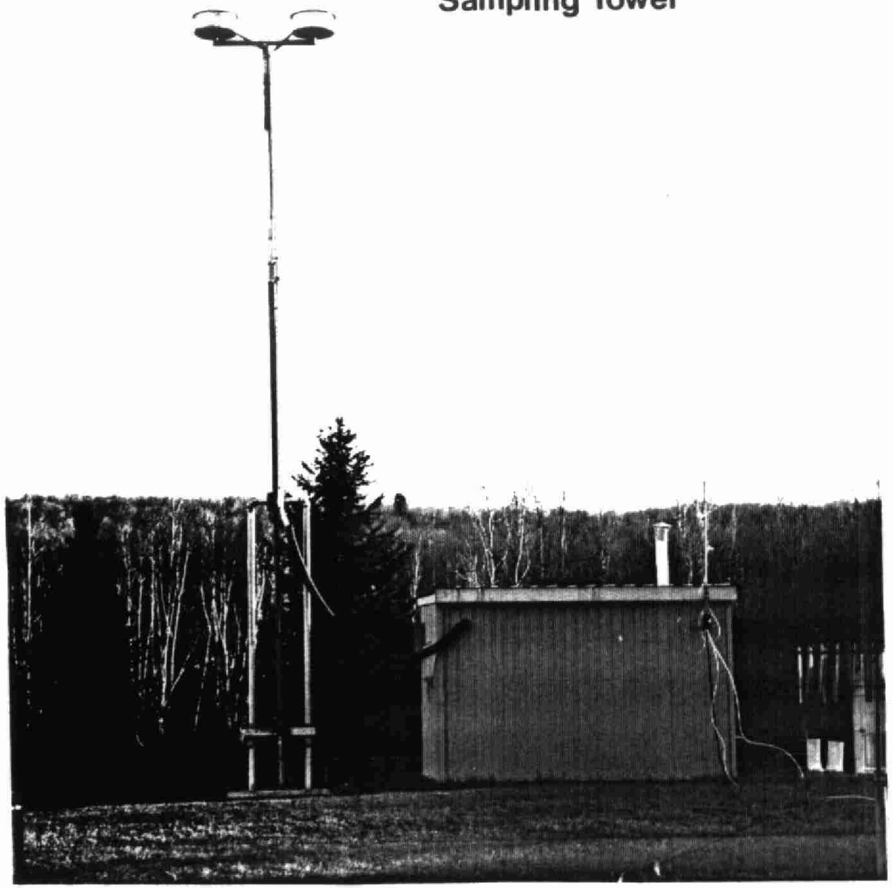
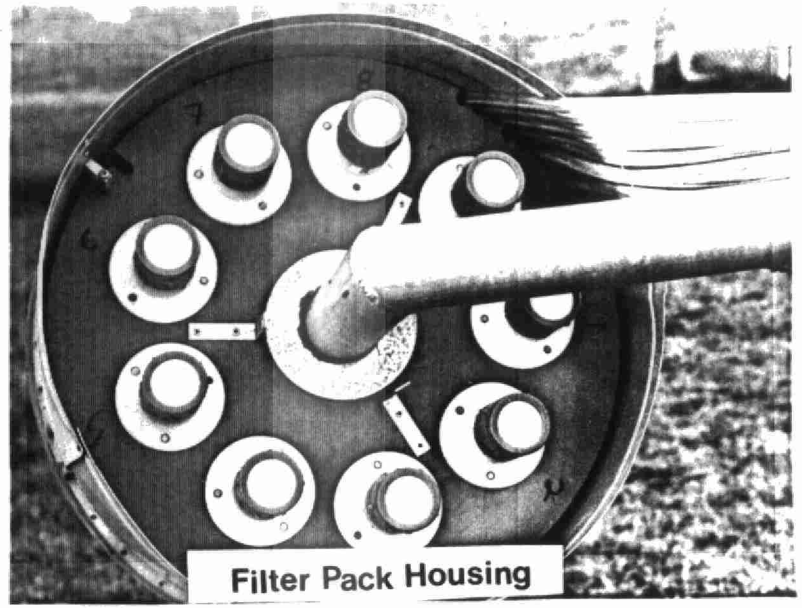
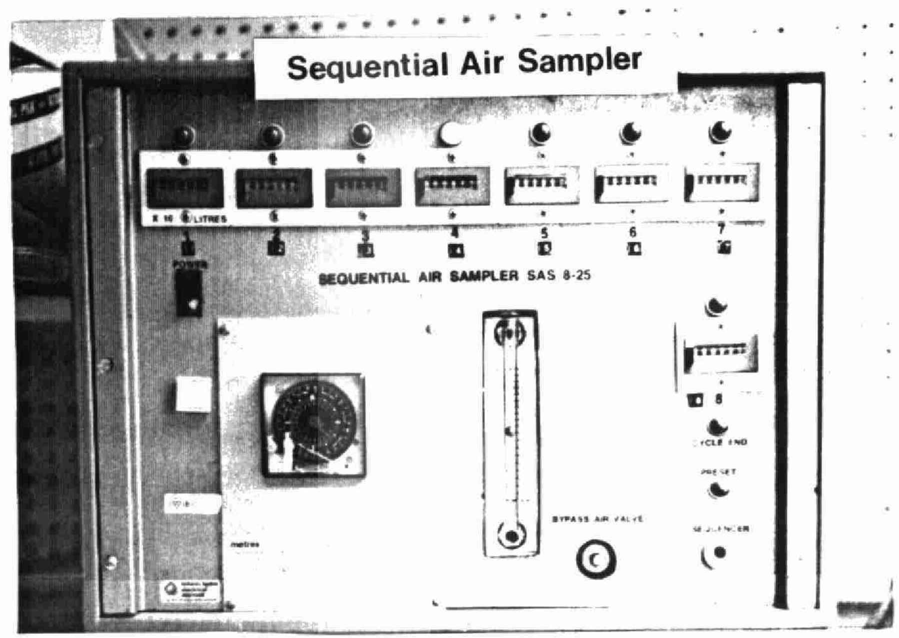


Figure 3. Instrumentation Used in APIOS
Dry Deposition Monitoring

Sampling Tower







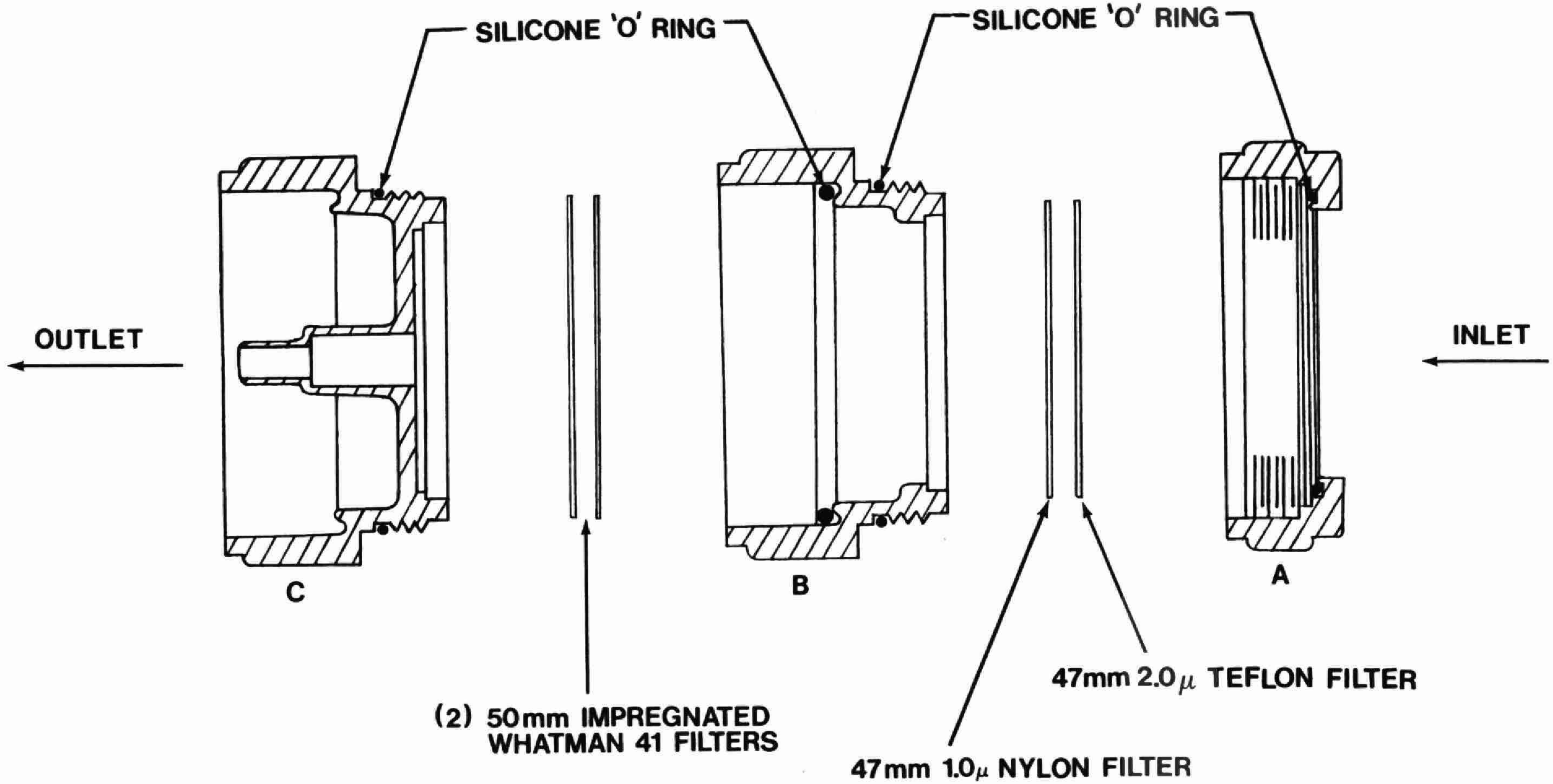


FIGURE 4:

CONFIGURATION OF FILTER TYPES USED IN APIOS EVENT DRY DEPOSTION MONITORING

TABLE 1

APIOS EVENT WET/DRY DEPOSITION NETWORK SITE LOCATIONS

AREA	MOE REGION	STATION NAME	INSTRUMENTATION	ELEVATION (m above MSL)	LATITUDE (North)	LONGITUDE (West)	UTM COORDINATES (Northing)	(Easting)
London	Southwestern	Longwoods	Wet and Dry	239	42°53'	81°29'	4747850	460700
		Melbourne	Wet	213	42°47'	81°33'	4736850	454600
		North Easthope	Wet	375	43°24'	80°53'	4805650	508650
		Wellesley	Wet	344	43°28'	80°46'	4812650	519500
Dorset	Central	Dorset	Wet and Dry	320	45°13'	78°56'	5009650	662400
		Nithgrove	Wet	325	45°12'	79°04'	5006800	651600
		Balsam Lake	Wet	259	44°38'	78°51'	4943400	670070
		Raven Lake	Wet	274	44°37'	78°54'	4941600	665750
Kingston	Southeastern	Charleston Lake	Wet and Dry	92	44°30'	76°03'	4927500	417150
		Graham Lake	Wet	130	44°35'	75°52'	4936750	431450
		Railton	Wet	156	44°23'	76°36'	4914700	373200
		Whitman Creek*	Wet	137	44°29'	76°49'	4927200	355100
		Wilmer*	Wet	145	44°27'	76°32'	4921500	378250
Atikokan	Northwestern	Fernberg	Wet and Dry	506	47°50'	91°52'	5316000	585000
		Forbes Twsp.	Wet	324	48°38'	89°37'	5388000	308000
		Quetico Centre	Wet	420	48°45'	91°12'	5399000	632000
		Lac La Croix*	Wet	368	48°21'	92°12'	5356000	558200

* Whitman Creek site removed from network November 1984; installed Wilmer October 1985 (replacing Whitman Creek)
Lac La Croix site removed from network March, 1984

Table 2

DAILY WET DEPOSITION NETWORK LABORATORY ANALYSES

PARAMETER	ANALYSIS METHOD	DETECTION LIMIT ($mg\ l^{-1}$)
pH (for H_f* determination)	Radiometer pH meter and Ingold low-conductivity combination pH electrode	0.01 pH units
Total Acidity (for H_t+ determination)	Gran titration: NaOH titration to a series of inflection points; results presented as $ug\ l^{-1}$ as H^+	0.01
Conductivity	Radiometer conductivity cell and meter	Depends upon range
$SO_4^{=}$	Ion Chromatography	0.05
$N-NO_3^-$	Ion Chromatography	0.01
Cl^-	Ion Chromatography	0.01
$N-NH_4^+$	Automated phenate-hypochlorite method	0.005
Ca^{++}	Flame Atomic Absorption	0.01
Na^+	Flame Atomic Absorption	0.005
K^+	Flame Atomic Absorption	0.005
Mg^{++}	Flame Atomic Absorption	0.005

* H_f - free hydrogen ion concentration
\+ H_t - total hydrogen ion concentration

Table 3

DAILY DRY DEPOSITION NETWORK LABORATORY ANALYSES

Parameter	Filter Type	Extraction Method	Analysis Method	Detection Limit (ug filter^{-1})
$SO_4^=$	Teflon	20 minute ultrasonic bath in 50 ml distilled de onized water	Ion Chromatography	2.00
$N\text{-}NO_3^-$	Teflon	same as above	Ion Chromatography	0.50
$N\text{-}NH_4^+$	Teflon	same as above	Automated Phenate-Hypochlorite Colorimetry	0.25
$N\text{-}HNO_3$	Nylon	20 minute ultrasonic bath in 25 ml 3 x 10^{-3} N NaOH	Ion Chromatography (as NO_3^-)	0.25
SO_2	Nylon	20 minute ultrasonic bath in 25 ml 3 x 10^{-3} N NaOH	Ion Chromatography (as $SO_4^=$)	1.00
SO_2	Impregnated Whatman 41 Cellulose	60 minute shaking in 50 ml 0.05% (v/v) hydrogen peroxide; followed by 20 minute ultrasonic bath in 50 ml hydrogen peroxide; followed by making up to 100 ml with hydrogen peroxide.	Ion Chromatography (as $SO_4^=$)	1.65

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Appendix 1

APIOS SITE DESCRIPTION QUESTIONNAIRE

Date: ____________________

COMPLETED BY: ____________________

REVISION NO: ____________________

Type of Site

(check one)

__ Existing Site (regular network)

__ Potential Site

__ Special Study Site

1. SITE IDENTIFICATION

Cumulative Wet ____________________ Cumulative Dry ____________________

Event Wet ____________________ Event Dry ____________________

Other (describe) ____

Station Name ____________________ Station Number ____________________

MOE Region ________________ County ______________ Township _______

Latitude _____° _____' _____" Longitude _____° _____' _____" Elevation _____m

UTM Co-ordinates E N

Name of Primary Operator ____

Alternate Operator ____

Regional Technician ____

Mailing Address (Primary Operator)

____

____

____

Phone (Primary Operator) _____/________ (Res) ____/________ (Bus)

Phone (Alternate Operator) _____/________ (Res) ____/________ (Bus)

Nearest APIOS Site Cumulative: Station Name ____________________

Distance ____________________ km

Event: Station Name ____________________

Distance ____________________ km

cont'd

2. **LIST OF INSTRUMENTATION** (if applicable)

1) Instrument Type: ______________________________

Cumulative Wet: ____________ Cumulative Dry: ____________

Event Wet: ____________ Event Dry: ____________

Other (describe): ______________________________

Manufacturer: ____________ Model #: ______

2) Instrument Type: ______________________________

Cumulative Wet: ____________ Cumulative Dry: ____________

Event Wet: ____________ Event Dry: ____________

Other (describe): ______________________________

Manufacturer: ____________ Model #: ______

3) Instrument Type: ______________________________

Cumulative Wet: ____________ Cumulative Dry: ____________

Event Wet: ____________ Event Dry: ____________

Other (describe): ______________________________

Manufacturer: ____________ Model #: ______

1) Standard Gauge Type ______________________________

2) Standard Gauge Type ______________________________

Other ______________________________

____

____

____

cont'd

3. **SITE LOGISTICS**

1) Is road access to site in summer: _____ good _____ fair _____ poor?

winter: _____ good _____ fair _____ poor?

2) Type of road surface? (dirt, gravel, oiled, paved) ______________________________

3) How far is the primary collector from road access? ___________________ m

4) If necessary, how close can a vehicle approach the collector? ___________________

5) If no road access to site, how is site reached? (plane, snowmobile) _______________

6) What is the available electrical power at site? ____________________

Volts _______________ Amps _______________ No. of circuits _____________

7) Is the circuit on a:

Receptacle GFIC ___________________________________

Circuit Breaker GFIC _______________________________

No GFIC ____

Battery ____

8) What is the distance from collector receptacle (or proposed site) to circuit panel?

_______________ m

9) What are the number of power failures per month? ___________________________

per year? _____________________________

10) Are there any other logistical problems which prevent the sampling site being easily approached or operated?

(locked gate, guard dog, flooding in spring?)

____

____

____

cont'd

4. TOPOGRAPHY AND LAND USE

1) Ground slope at site:____%

2) Ground cover within 15 m of sampler (grass, scrub, gravel, sand, soil)

____

3) Soil type within 10 m of site (sand, topsoil, clay, rocky)

____

Soil type within 500 m of site (sand, topsoil, clay, rocky)

____

4) Land use % near site, within 1 km/10 km

% Cultivated ____________________/________________________

% Orchard ______________________/______________________

% Lawn ________________________/______________________

% Pasture ______________________/______________________

% Forest _______________________/______________________

% Water _______________________/________________________

% Other (describe) ______________/______________________

Type of Cultivated crop(s) _______________________________

Forest types within 1 km of site ___________________________

5) What types of windbreaks are within 200 m of primary sampler (buildings, trees, hills) ____

6) Indicate any windbreaks within 200 m of primary sampler (Mark what quadrants of the compass have a windbreak)

cont'd

7) Prevailing wind direction during event (according to Operator)

Winter ______________________°

Summer ______________________°

8) Comment on local topography (i.e. flat, hilly, river, basin, etc.)

____

____

____

____

____

____

9) Cultivated Land Use

Type of Crop	Type of Herbicide or Insecticide Used and when applied	Type of Fertilizers and when applied	Future Crops	Distance to Crops	Direction to Crops

cont'd

10) Any planned land use in future? ______________________________

____

____

11) In winter is there any evidence of drifting snow? ______________________________

12) Tall objects near sampler:

i) Trees ______________ (species) Max Height ______________ m

Distance ______________ m Direction ______________ °

ii) Buildings ______________ (type) Height ______________ m

Use ______________ Type of Heating ______________ Distance ______________ m

Direction ______________ °

iii) Other (overhead wires, telephone poles, hedges)

A) Object ______________ Height ______________ m

Direction ______________ ° Distance ______________ m

B) Object ______________ Height ______________ m

Direction ______________ ° Distance ______________ m

C) Object ______________ Height ______________ m

Direction ______________ ° Distance ______________ m

D) Object ______________ Height ______________ m

Direction ______________ ° Distance ______________ m

Comments ______________________________

____

____

____

____

____

____

cont'd

5. HUMAN ACTIVITY

1) Large highways (expressways): Distance ______________ (Km, m)

   Route # ______________ Direction from Sampler ______________

2) Other paved roads: Distance ______________ (Km, m)

   Direction from sampler ______________

   traffic: Heavy ______________, Medium ______________, Light ______________

3) Unpaved road: Distance ______________ (Km, m)

   Direction from sampler ______________

   traffic: Heavy ______________, Medium ______________, Light ______________

   Surface (dirt, gravel, oiled) ______________

4) Parking lot: Distance ______________ (Km, m)

   Direction from sampler ______________

   Unpaved ______________ Surface material ______________ Use: Continuous ______________

5) Lake/river or rail traffic: Distance ______________ (Km, m)

   Direction from sampler ______________ barge ______________

   lake steamer ______________ rail ______________

   traffic: Heavy ______________, Medium ______________, Light ______________

6) Snow clearing procedures:

Type of surface (road, parking log, hwy, walkway)	Surface distance from sampler	Direction from sampler	Snow Control (plowed, sanded, blown, salted- with what?)

cont'd

7) Airport(s): Distance ______________________________ (Km, m)

Direction from sampler ______________ Name ______________

traffic: Heavy ____________, Medium ____________, Light ____________

traffic type: ______________________________

8) Stationary sources:

Power plant(s): Distance ______________________________ (Km, m)

Direction from sampler ______________ Fuel (gas, coal) ______________

Electrical Capacity ______________________ (KW_e, MW_e)

Light industry: Name ______________________ Distance ________ (km)

Direction from sampler ______________________ Product ______________

Heavy industry: Name ______________________ Distance ________ (km)

Direction from sampler ______________________ Product ______________

9) Other sources: Significant agricultural operations:

Distance ______________________________ (Km, m)

Direction from sampler ______________________________

Other (please describe) ______________________________

____

Distance ______________________________ (Km, m)

Direction from sampler ______________________________

Other could include - gravel pits, sewage lagoons, marshes, MTC,

Salt or Sand piles - (see Topographical Maps)

cont'd

10) Effects from local cities, towns, or villages (population)

A	100,000
B	10,000
C	5,000
D	1,000

NAME	POPULATION (letter code)	DISTANCE	DIRECTION	TYPES OF POLLUTION SOURCES

cont'd

6. SITE SUMMARY

List deviations from site criteria and all advantages and disadvantages of this site.

(use reverse side if necessary)

cont'd

7. **SITE LOCATION**

1) A topographic map (Scale 1:50,000) indicating sample site with a Red X.

   - arrows on top map indicating best approach from nearest "MAIN" Highway.
   - indicate with red dots any major sources of pollution of contamination (industry, gravel pits, towns)

2) A concise description on how to reach this site. (below)

cont'd

8. SITE DIAGRAM

1) Notable Items (mark all distances)

1. North
2. Direction of prevailing winds
3. Windbreaks
4. Roads (with names)
5. Parking lots
6. Buildings (indicate type of heating)
7. Potential contamination sources
8. Ground cover (grass, scrub, soil, sand)
9. Trees/hedges/marshes
10. Obstructions (include height): poles, towers
11. Topography
12. Water
13. Crops/gardens
14. Paths (foot, snowmobile, ski)
15. Location of existing hydro facilities
16. Position of sampler(s)
17. Nature of soil (rocky, sandy, clay)

2) Legend

Coniferous trees (include height, H=)

Deciduous trees (include height, H=)

Wooden fencing (include height, H=)

Wire fencing (include height, H=)

Grass

Direction of ground slope

Bushes/hedges (include height, H=)

Buildings (height and heating)

Railway tracks

cont'd

9. **SITE PICTURES** (Indicates site name, compass point and date of photograph on back of all slides)

1) Two pictures are to be taken so as to best include all sampling instrumentation on site. If possible take pictures 90° apart from each other. Indicate on Site Diagram as P1 and P2 where the pictures were taken from. Also, identify each picture on a list of photographs.

2) Take four pictures showing the area surrounding the site. These should be taken at four compass points from just behind primary sampler facing in the direction of the compass point.

3) Special pictures showing nearby potential sources of contamination (e.g. salt pile) that may affect the site are to be taken. These should be indicated, if possible, on a site diagram as SP1, SP2, etc. with a description of the picture on the back of the print.

LIST OF PHOTOGRAPHS

#	Direction Facing	Comments

6AR14-Fig.25